Design and Development of the NEA Scout Boom Deployer

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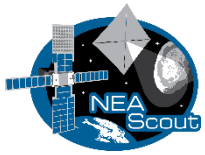
43rd Aerospace Mechanisms Symposium

Agenda

- **System Overview**
  - NEA Scout Overview
  - Flight System Configuration
  - Solar Sail Subsystem Configuration
- **Design Evolution**
  - Prototype Development
  - Blooming
  - Engineering Development Unit
- **Deployments**
  - ½ Scale Deployments
    - Boom Only
    - Integrated Sail & Boom System



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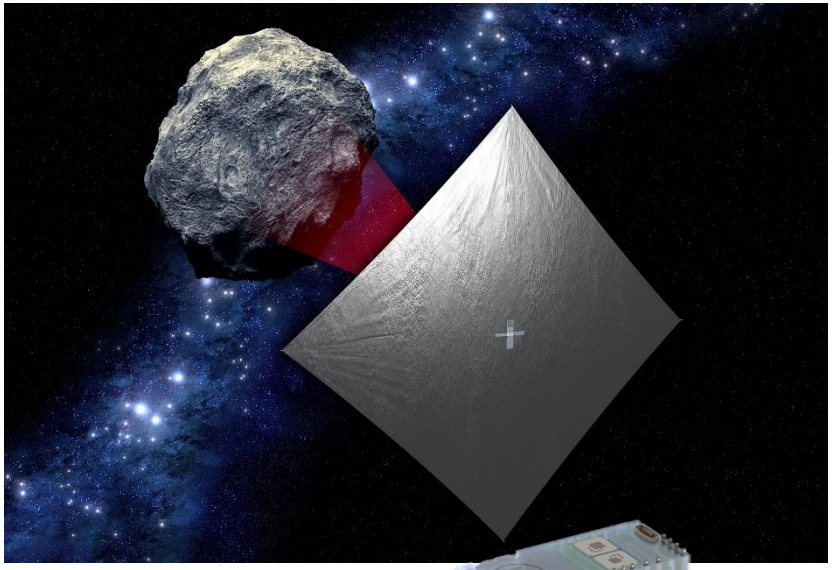
SYSTEM OVERVIEW

Near Earth Asteroid (NEA) Scout Overview

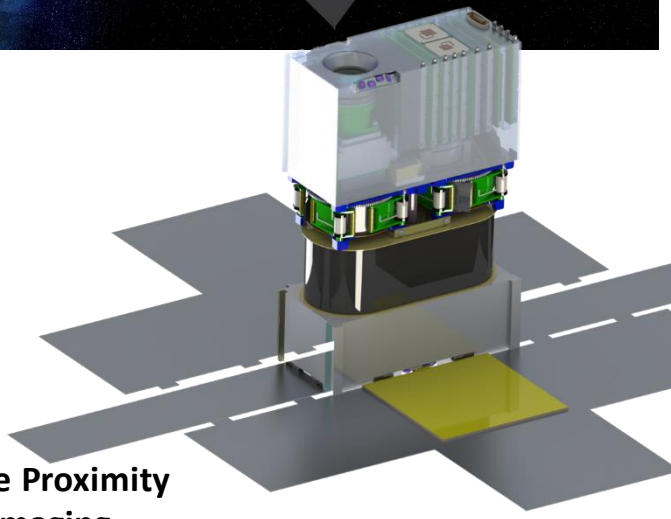


The Near Earth Asteroid Scout Will

- Image/characterize a NEA during a slow flyby
- Demonstrate a low cost asteroid reconnaissance capability

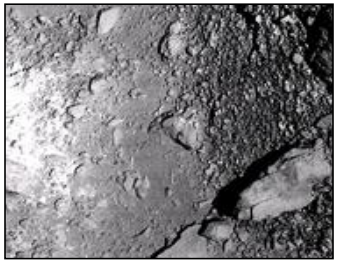
Key Spacecraft & Mission Parameters

- 6U cubesat (20 cm X 10 cm X 30 cm)
- ~86 m^2 solar sail propulsion system
- Manifested for launch on the Space Launch System (EM-1/2018)
- Up to 2.5 year mission duration
- < 1 AU maximum distance from Earth



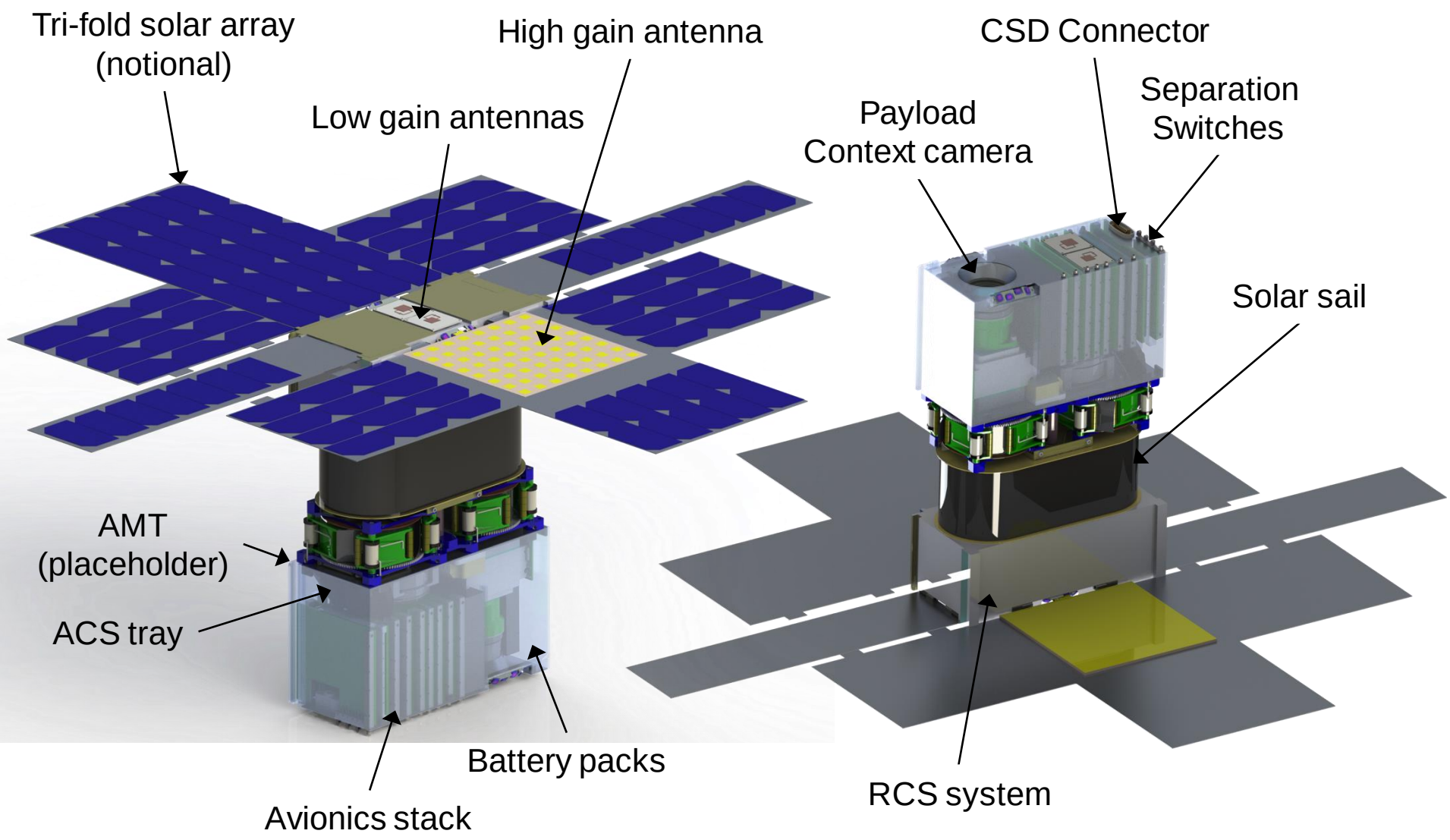
Leverages: Combined experiences of MSFC (PM, SE, Solar Sail, AMT, G&C, and Mission Ops) and JPL (Flight System Bus, Instrument and Science) with support from GSFC, JSC, & LaRC

Target Reconnaissance with medium field imaging
Shape, spin, and local environment



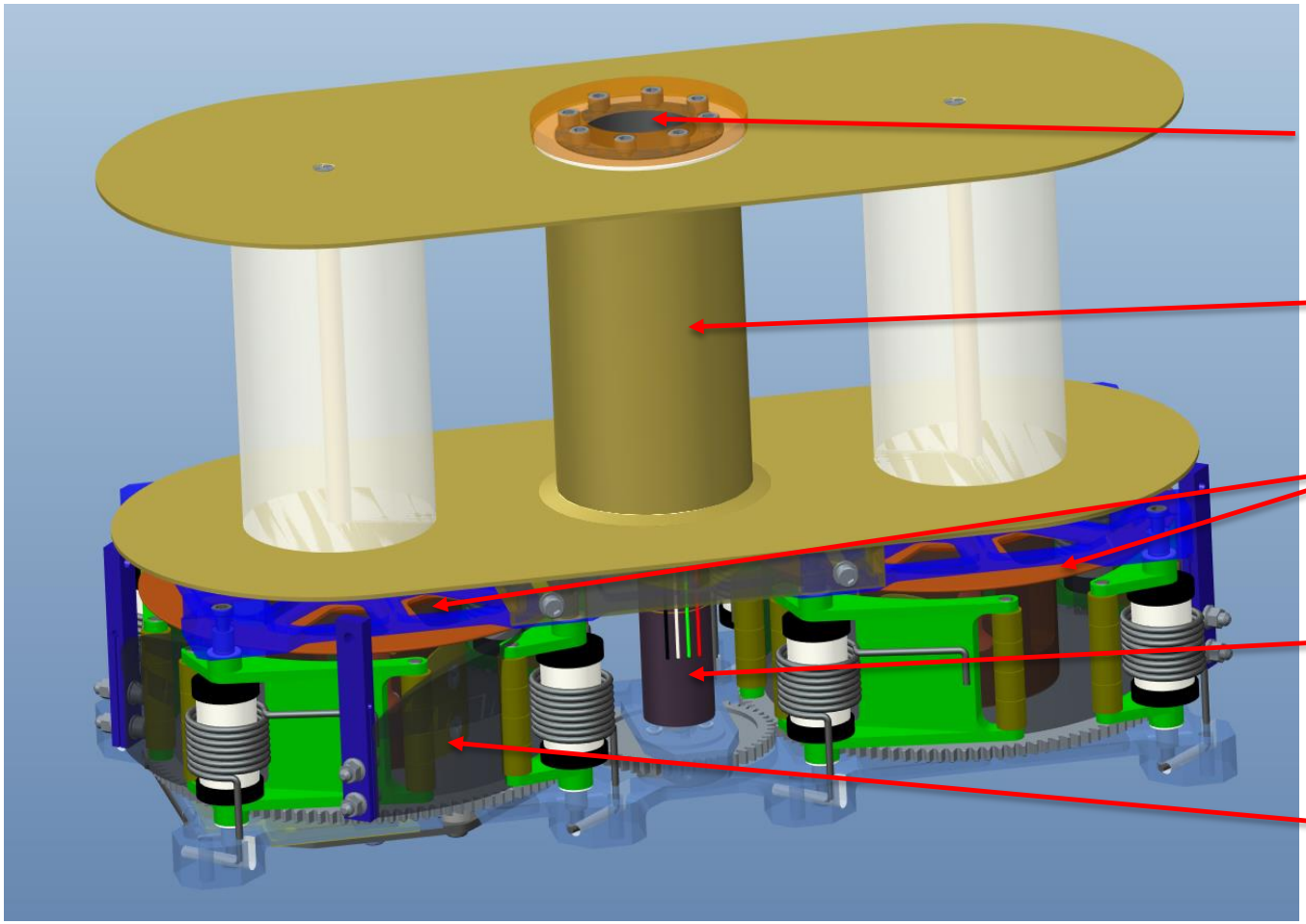
Close Proximity Imaging
Local scale morphology, terrain properties, landing site survey

NEA Scout Flight System Configuration



Integrated flight system, stowed sail; Credit: JPL

Solar Sail Subsystem Overview



Solar Sail Subsystem without sail, Credit: NASA

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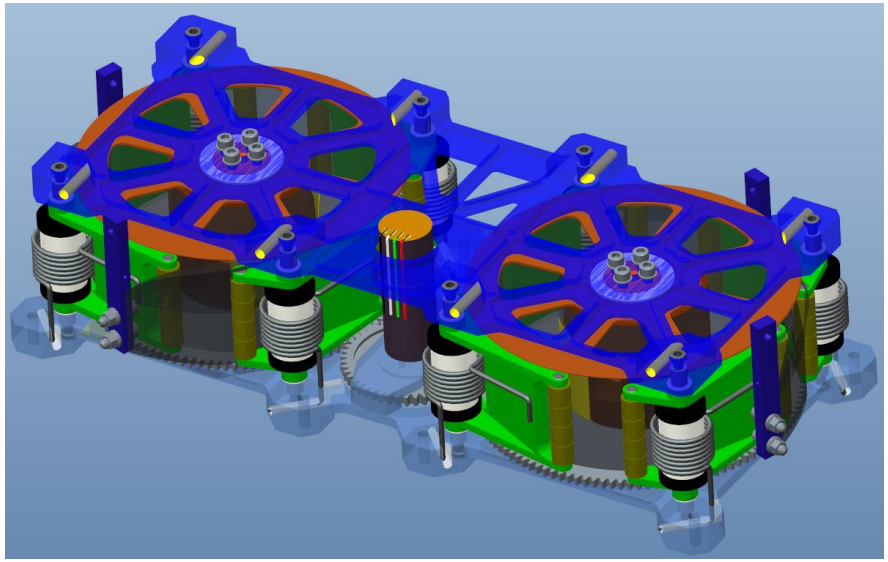
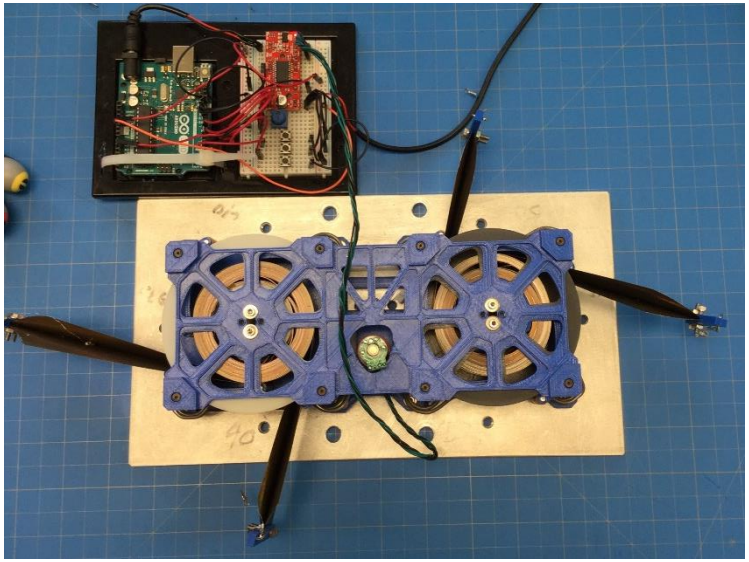
DESIGN EVOLUTION

Boom Deployer

- Four, 6.8m spooled Triangular Rollable and Collapsible (TRAC) Booms
- Deploys in four cardinal directions
- As booms deploy, the sail is pulled out
- Boom deployer is designed to avoid ‘blooming’ of the booms during deployment
- Deployment is controlled by a single stepper motor



CAD Render, Credit: NASA



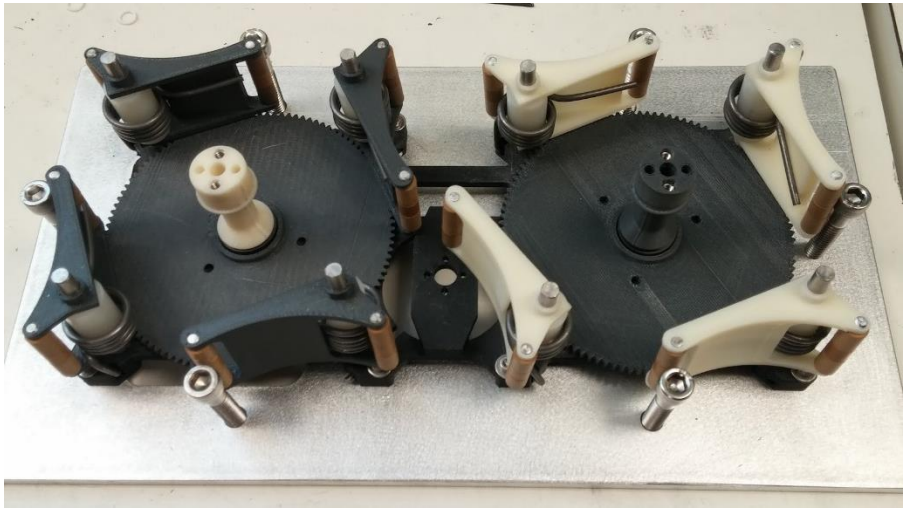
3D Printed Prototype, Credit: NASA

Boom Deployment ‘Blooming’

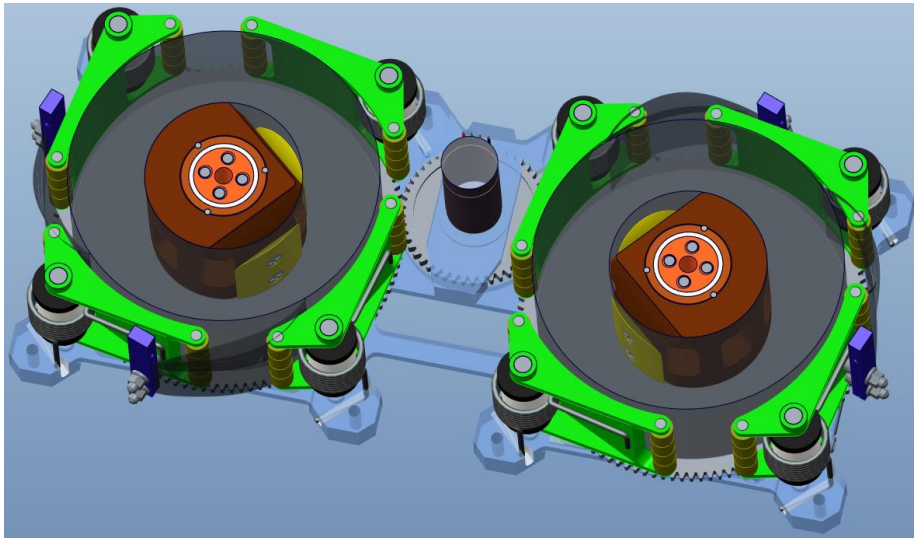
Early prototype, Credit: NASA

Boom Deployer Arms

- Pressure arms are loaded at 35-45N with torsion springs at the point of contract with the booms
- Rulon J sleeve bearing used as rollers on the deployer arms to reduce friction
- Motor must overcome several points of friction in the deployer system, the largest of which occurs at the boom deployer arms contact point with the boom spool

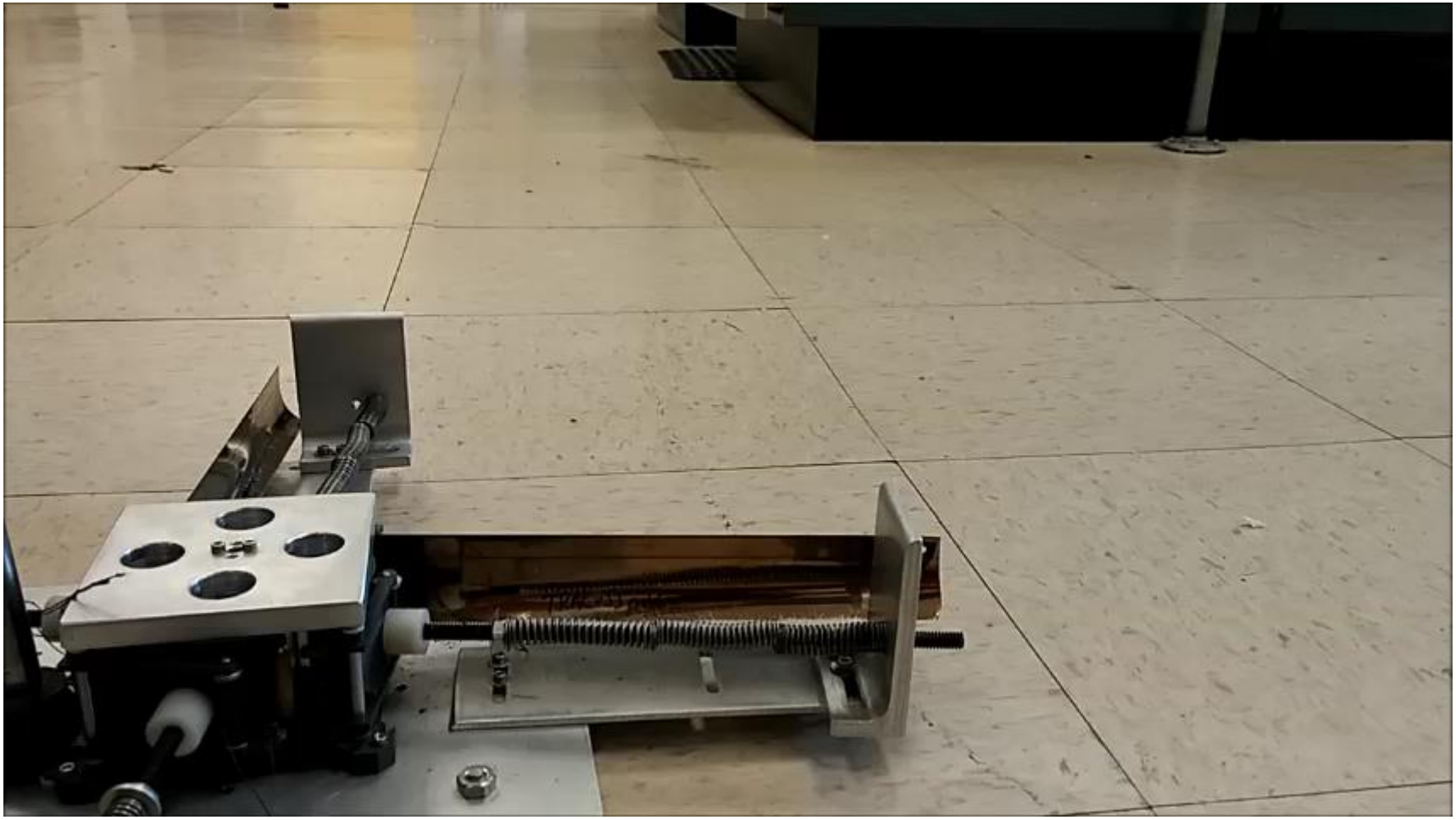


Early prototype, Credit: NASA



CAD render of boom arms, Credit: NASA

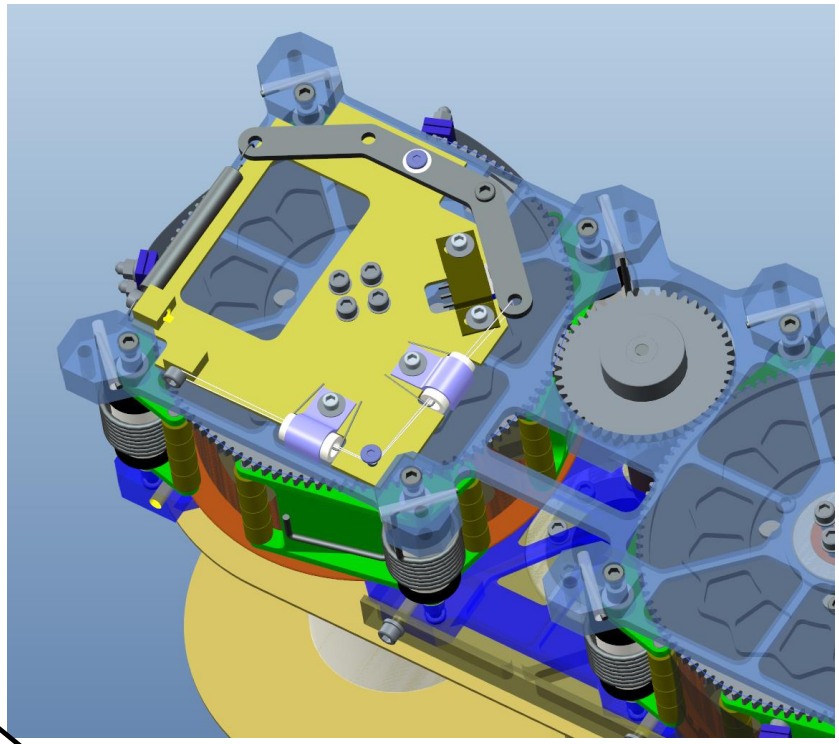
Test Deployment with Linear Springs

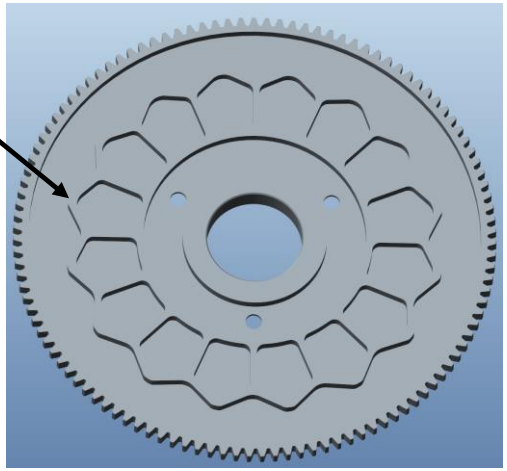


Early prototype, Credit: NASA

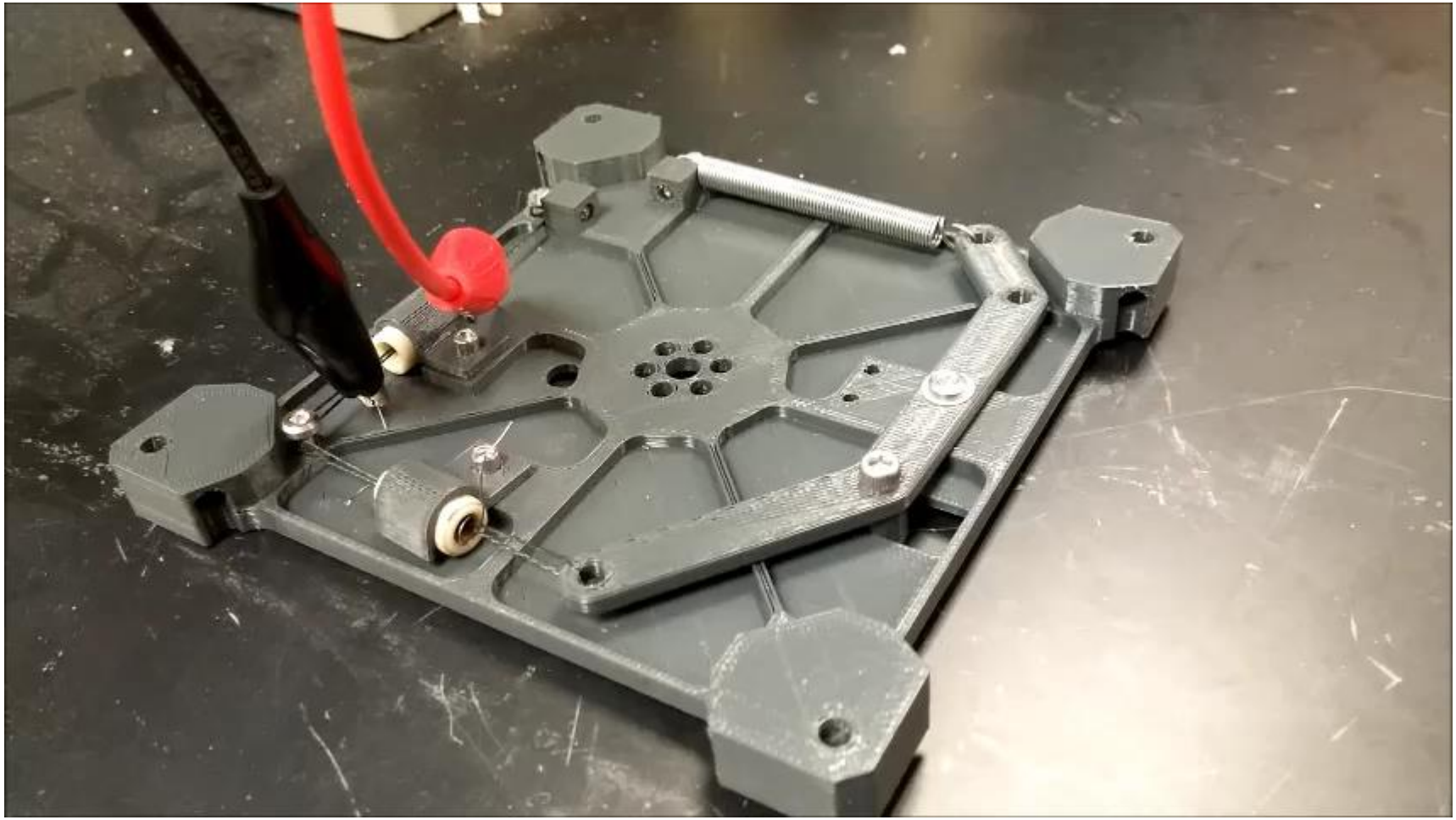
Burn Wire Inhibit Mechanism

- Consists of two heaters made from NiCr wire encased in a ceramic sleeve
- Spring loaded arm is held down with Honeywell Spectra Monofilament which passes through the two NiCr heaters
- In the locked condition, the spring loaded arm places a bar into the ‘spokes’ of the gear, which does not allow the gear to rotate
- When activated, the heater melts through the Spectra Monofilament, allowing the bar to be pulled from the spokes and allowing the gear to rotate freely



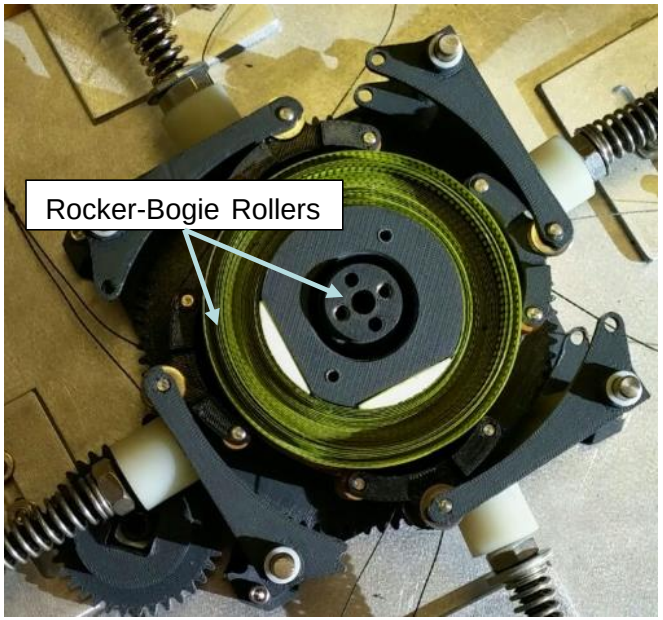


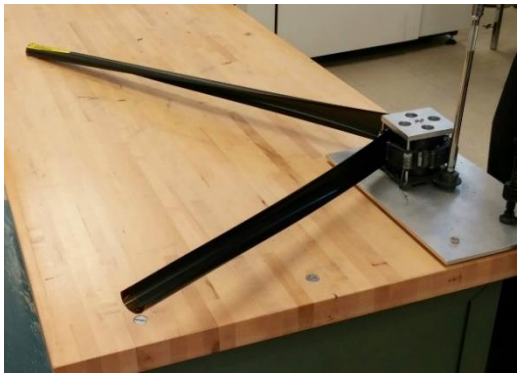
Burn Wire Mechanism



Further Improvements

- **Constant force spring or power spring to replace extension spring**
- **Use of Rocker-Bogie to control blooming**
- **Rough surface finish of boom hinders wrap-to-wrap boom slippage**
- **Use split tape composite boom**
  - Significant stain energy reduction
  - High friction between wraps
  - High packaging efficiency
  - Reduce thermal deflection





Composite Split Tape & Rocker-Bogie Deployer

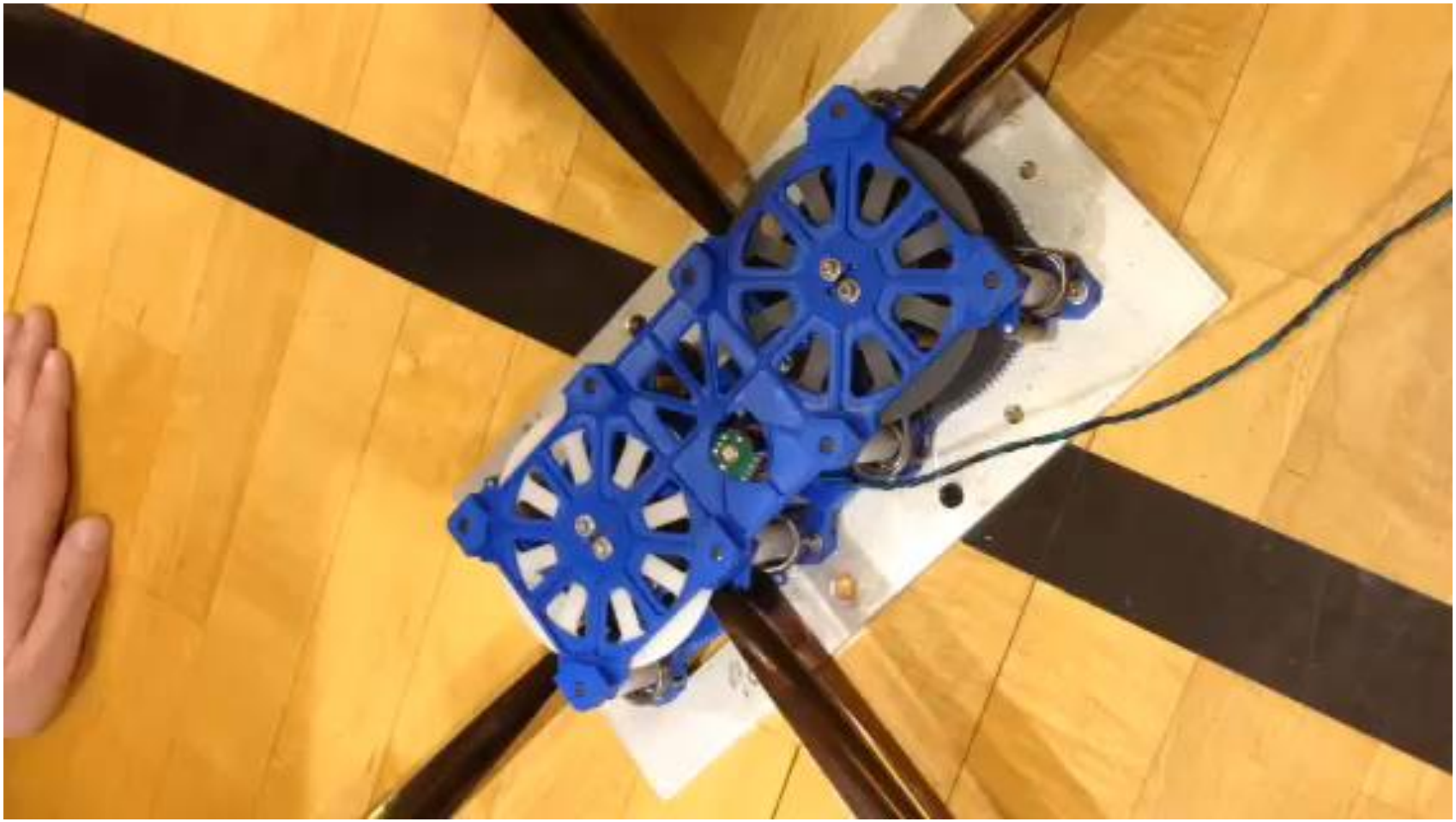
Alternative Boom Deployments

Composite Split Tape Deployment

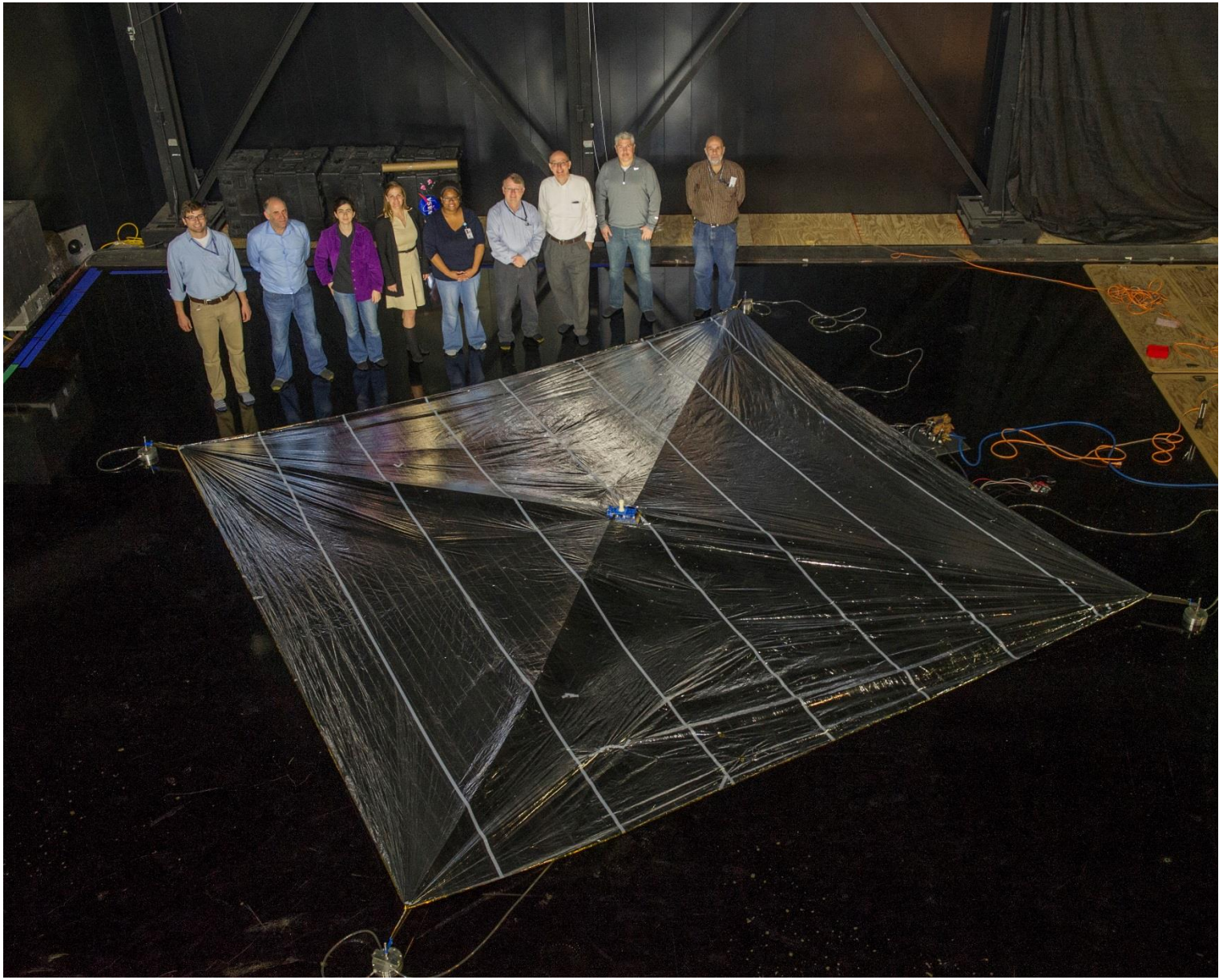
Metal Split Tape (Tape Measure Self Deployment)

½ Scale Deployment – January 2016

½ Scale Deployment – Retraction



QUESTIONS?



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